OSP for the GlueX FDC Prototype Cathode Chambers

1 Introduction

The purpose of this OSP is to provide an overview of the test setup associated with the GlueX Forward Drift Chamber (FDC) prototype and detector test stand located in EEL 126. This document describes the detector and associated hazards, and outlines the operational procedures. A list of personnel who are authorized to operate the FDC chamber and associated equipment is given at the end of this document.

2 Description of the Test Setup

The test setup covered by this OSP includes a set of horizontal drift chambers and plastic scintillators that make up a cosmic ray test stand, prototype FDC cathode chambers, along with racks of electronics and power supplies. Each of the individual elements is described in more detail below.

The purpose of the test stand is to study the performance of a full-scale FDC prototype (described below), but for purposes of initial setup we may use the existing small-scale prototype, which consists of two planes of cathode strips sandwiching a plane of anode wires in a 12 in $\times$ 12 in grounded aluminum case. The cathode strips are held at ground potential with the sense wires at positive high voltage ($\sim$2.5 kV) and the field wires at a lower negative high voltage ($\sim$-0.5 kV). The high voltage is supplied by a Bertan 375 2-channel 5-kV power supply located in the electronics rack. Most of the readout channels (cathode strips and anode wires) have their own associated "SIP" preamplifier. The power requirement for a single SIP is 5 VDC at 13 mA, and is supplied by a low-voltage power supply. The maximum number of SIP preamplifiers mounted on the FDC prototype chamber is 80 (4$\times$16 cathode channels and 16 anode channels). We are also testing out a small number of ASIC preamplifier boards that require 3.2 VDC (supplied by a low-voltage power supply) and draw about 280 mA. The baseline gas mixture for the chamber is a non-flammable mixture of 40% Argon - 60% CO_2. We plan to pursue a program of adding a small admixture of methane to the gas mixture if needed.

The full-scale prototype consists of 3 cathode-anode-cathode sandwiches in a stack whose diameter is about 1.2 m. Each anode layer consists of 96 sense wires and 97 field wires. The sense wires are biased to about +2.5 kV and the field wires to about -0.5 kV. Each group of 12-20 sense wires is fed by a single high voltage channel, with a similar configuration for the field wires. The cathodes are divided into 196 strips, all of which are at ground potential. The wires and cathode strips are read out with 24-channel preamplifier cards housing three 8-channel ASICs as mentioned above. The positive HV is supplied by a CAEN A1535P module and the negative HV by a CAEN A1535N module occupying two slots in a SY1527LC mainframe.

The cosmic ray test stand that has been assembled to test the FDC prototype chambers consists of nineteen 1-m long chambers constructed from an aluminum case (held at ground potential) with anode wires inside at positive high voltage (2 kV). We also have a set of smaller chambers that serve the same purpose for a more localized area. The high voltage is supplied by a CAEN 472 4-channel 6-kV power supply located in the electronics rack; we may also use one of the Bertan supplies for this purpose. The high voltage for each chamber in the test stand is connected via a daisy-chain configuration through 5-kV rated high voltage jumpers. Each chamber is read out through a chamber-mounted LeCroy 2735 preamplifier/discriminator card whose power is supplied by a power distribution center located in the electronics rack. This power distribution center supplies ± 5 V to the cards. A separate power supply provides the reference voltage for the card threshold. The maximum current draw per card is 12 mA. The configuration for the smaller chambers is the same. These chambers operate with a non-flammable mixture of 90% Argon/10% CO_2. The total gas flow rate through all detectors in this setup is very small at $<$100 cc/min. The gas is passed through a mineral oil bubbler and vented outside the building through a penetration in the wall.

The detectors in the test setup are mounted on a sturdy support frame. The chambers are mounted on the top and bottom surfaces of the frame. The FDC prototype chamber is mounted within the cosmic ray test stand on a separate support shelf. A set of plastic scintillators, placed on the aluminum frame above and below the prototype is used to trigger the event readout. These scintillators are set at a high voltage of 1.-1.5 kV via two CAEN A1733N modules mounted in the CAEN SY1527LC mainframe.

Finally, our test setup includes a rack of electronics consisting of NIM, CAMAC, and VME crates, a power distribution center for the detector preamplifiers, and a power supply for the preamplifier threshold voltage. Our data acquisition computer is located next to the readout electronics. A photograph of our complete test setup is included in Fig. 1.

3 Hazards

The main hazard within this test setup is from electrical shock from the high voltage for the detectors. Each of the chambers operates at roughly 2 kV. Maximum operational currents are below 1 μA for the entire set of detectors. We have taken care to design controls to mitigate the hazard. These include:

1). Engineering Controls:

- The high voltage circuit boards for the large external chambers are covered with thick Plexiglas shields that prevent access to them when the detectors are energized.
- All cables running from the high voltage power supplies to the chambers use shielded cables with either standard SHV connectors or Radiall multi-pin connectors at each end. The cables are run away from human traffic areas.
- The chambers are grounded to the electronics rack.

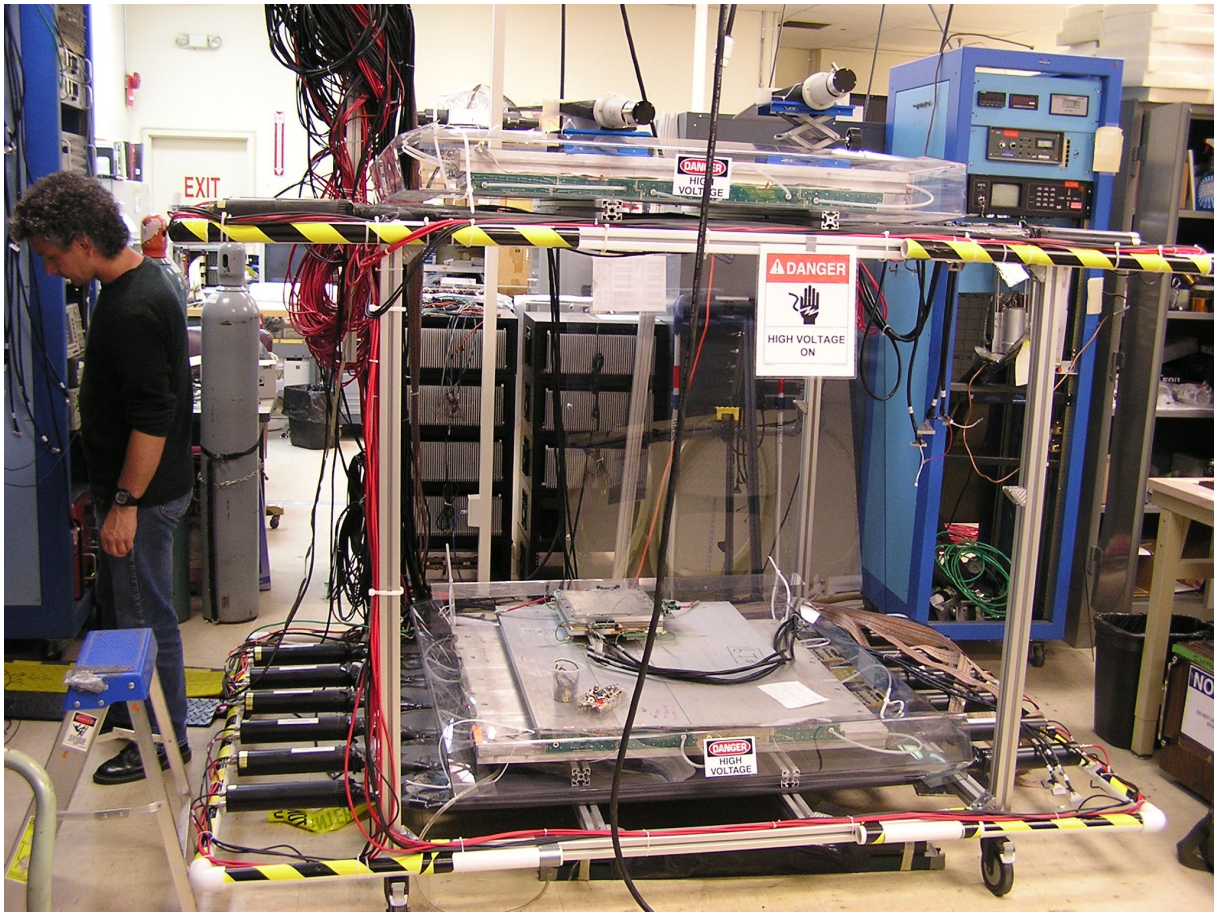

Figure 1: Photograph of the test setup for the FDC prototype studies.

- The high voltage power supplies are set to a maximum current draw of 10 μA. If they reach this limit for any reason, they will immediately shut down.

2). Administrative Controls:

- The Plexiglas high voltage shields described above each have a large sticker with the warning "Danger: High Voltage" to alert personnel of the potential hazard.
- A placard with contact information for our local personnel is placed on top of the detector.

Gas cylinders (Argon, carbon dioxide, and a 90/10 Argon/CO_2 mixture) are in use during the operation of the chambers.

1). Engineering controls

- The gas cylinders will be capped off when not in use.
- The gas cylinders will be equipped with appropriate regulators when in use.
- The gas cylinders will be secured to a table or the wall.

Other potential hazards include trip hazards due to cables on the floor. All cables where possible are routed overhead. Those cables/wires that are too short to route above head are placed within a floor cable mat.

4 Procedures

For tests of small regions of the prototype the chamber high voltage can be supplied by either the CAEN NIM power supply or the Bertan power supply. Both supplies have front panel LEDs that illuminate when they are energized. The CAEN high voltage is set via a front panel screw, while the Bertan supply high voltage is set via a front panel dial. These power supplies are set to trip whenever their supply current exceeds 10 μA and the currents are continuously monitored. Only the trained personnel listed at the end of this document are authorized to energize the power supplies. Whenever the chambers are energized, the power supplies will be set so that if they trip off, they will need to be manually reset by an operator.

The gas for the external (non-FDC prototype) detectors is provided via a pre-mixed gas cylinder with gas lines passed through a needle valve flow controller located next to the chamber location. The gas for the prototype is provided via a mixing system whose inputs are gas cylinders individually equipped with regulators. The flow of the mixed gas is set to 50 cc/minute.

At the end of the tests, the gas cylinders will be disconnected and capped.

5 List of Personnel Working on the Project

The individuals whose signatures appear below are authorized to operate the detectors in this test setup associated with the GlueX FDC prototype cathode chambers. The detector and associated equipment are located in EEL 126. The signatures indicate that each person has read and understood the contents of this document and agrees to strictly follow the established operational procedures. A name can be added to the list below only by Simon Taylor and only after the person has read and understood the contents of this document and has had the hazards and operational procedures explained to them by the existing authorized personnel.

Personnel	Read and Understood
Beni Zihlmann	
Simon Taylor	
Brian Kross	
Fernando Barbosa	
Mark Stevens	